

Lean meets Industry 4.0

Incompatible or consequent further development?

Lean approaches, especially in production are often considered outdated and antiquated. Especially, they don't fit in the beautiful new world of industry 4.0 and digitization. Therefore, it is time to bring the two seemingly irreconcilable worlds a little closer together. Industry 4.0 is rather the consequent further development of well-known Lean approaches. This is the only way to successfully implement transformation projects.

Lean approaches can be very well combined with Industry 4.0 approaches

An essential characteristic of Lean is that it runs through the entire company, from strategy to the work process. It is, just like Industry 4.0, a so-called holistic approach. Derived from the goals "maximum customer satisfaction" and "minimum waste", the implementation in the company follows.

Principles like "Zero defect", "Visual Management", "self-control", and "Kaizen" find themselves in Industry 4.0 approaches like "predictive X", "assistance systems", "autonomous processes" and "agile self-organizing". Even apparent contradictions like e.g. standardization of workflows or technical equipment find their validity in other application areas, e.g. in interfaces or data formats.

Tools and methods have been developed for Lean implementation and operation. A well-known method for example is the value stream design. It leads to a structuring of production (product families) and a logistically continuous designed balanced process chain. The method can also be used to identify application areas for Industry 4.0 in product optimization (e.g. automation of process feedback). Another example is the shop floor management. Through appropriate networking and transparency, at the information level, decisions can be quickly in a meeting based on a real time image of the production (digital shadow).

Why another transformation?

In many companies, the potential of Lean transformation is exhausted after decades of transformation. The pressure for further flexibility and cost reductions, demographic change and the shortage of skilled workers are now forcing companies into the digital transformation towards a Smart Factory.

The world and thus the demands for an economically active company have changed massively. Shared Economy, personalized products and closed cycles of materials are well-known buzzwords that stand for the major changes. The motto is simple: faster, more flexible and more sustainable. These are the challenges for the production site Germany and thus for the companies producing here. A quick reaction to volatile markets and demanding customers is therefore one major challenge. Industry 4.0 and Smart Factory can make an important contribution – in connection with Lean.

For optimization reasons, many companies currently have a fixed interlocking of single manufacturing and production areas. This is also reflected in the corresponding organization structures. As consequence of this approach, it leads to very low flexibility on all areas. This makes it difficult to react to changing conditions, such as fluctuations in capacity utilization or a changed product portfolio during operations.

Thus, changes are associated with a corresponding financial expense. At the same time, such systems can only be scaled to a limited extent, since planning and optimization is based on maximum utilization. Thus, it is very difficult to meet additional requirements economically using such approaches.

A Smart Factory's setup

The Smart Factory's setup is intended to illustrate the consistent further development of lean approaches. This also makes sense, since lean and stable processes should be the starting point for any approach towards a smart factory. "A fool with a tool is still a fool". This quote, which has been known from computer science for a long time, also applies to the Smart Factory. The fallacy that lean processes and a corresponding transformation are obsolete is mainly due to corresponding transformation projects in China – and they fail regularly. In the Middle Kingdom, Lean is often regarded as an outdated approach that can be simply be skipped – unfortunately wrongly, as we will see later in this article.

Unfortunately, also in a Smart Factory it is necessary to introduce successive improvements - i.e. to continuously improve existing processes in their entirety or event to redesign them. The aim is to implement a digital value-added system. Even in the Smart Factory, the credo applies: "Not working harder, but smarter and more productively" and to use the human resource in a particularly "intelligent" way. As with Lean Transformation, the involvement of the company's own employees in the entire transformation process is a decisive success factor. In the context of digitization and Industry 4.0, it is often referred to agile, decentralized control or autonomous units.

In a Smart Factory, customer orientation means the vertical and horizontal integration of all business areas and thus from partners and customers. In order to serve the markets and thus the customers economically, the classic flexibility approaches such as resources or part reservations are by far not sufficient. A versatile factory and thus a corresponding value-added and production system must be built up, i.e. a high degree of scalability, modularity, compatibility, universality and neutrality must be realized.

This means that series production as well as batch size 1 can be configured, depending on requirements. Irrespective of the many technical possibilities for change, which will be dealt with only marginally here, a holistic approach must be taken. Isolated measurements lead only to isolated improvements.

Value-added system from the world of Lean

This means that despite considerable financial efforts, the potential is not being fully exploited. In the following, a holistic approach in form of a "Smart Factory Production System" – i.e. a further developed value-added system from the world of Lean - is pursued. This ensures that the successes from Lean transformation are not only maintained in the Smart Factory, but also consistently continued, thus achieving the expected potentials and thus productivity increases.

In the Smart Factory, the real world merges with the virtual world. Novel production approaches are possible using the digital shadow/twin. The "part controls the process". Thus,

a complete networking and communication of all process participants (machines, tools, products, parts, systems and humans). Everyone involved in the process has its own Internet address and can hereby at any time be contacted, configured and is capable of self-disclosure.

Real time “Swarm Intelligence” leads to further increases in productivity and flexibility through direct and immediate control and communication of all process participants. Consequently, in addition to the classic and monolithic and thus indirect and reactive MES (Manufacturing Execution System), direct and immediate control by the product itself – of course in cooperation with existing systems such as SAP and MES. Rigid organizational structures are broken down in a Smart Factory. The next “constructive destruction” from the world of Lean goes into the next round.

Advanced Analytics approaches

In concrete terms, the price and time conditions at which the requirement can be met can be determined as early as the customer enquiry, virtually in real time. Once a customer order has been received, it is transferred automatically (as much as possible) to the factory without waste. The order is controlled by itself according to the customer’s requirements and deadline.

Demand planning and material supply is carried out using Big Data systems and Advanced Analytics approaches in order to forecast demand as precisely as possible according to the market situation. The material is scheduled accordingly using rolling rough-cut planning based on concrete and estimated requirements and sales orders.

Overall, the result is a consistent continuation of the classic Lean based value-added system towards a Smart Factory value-added system. Technologies represent in this approach the enabler for further improvements – across all areas of the added-value system. However, technology is “only” an enabler for further improvements and it has to be exchangeable in its practical implementation. This is already absolutely necessary due to the fast further development of the individual technologies in the factory.

Shared economy

Technology influences all areas of the further developed value-added system, as the previous explanations also show. The aim is to develop an intelligent and for customer and partners open value-added system based on Industry 4.0. One striking technology are platforms for operating agile temporary networks. They support the so-called “shared economy”. Here, the level of automation is not in the foreground of the implementation. Excellent processes have to be implemented in the Smart Factory with a corresponding contribution to value added. The goal is to achieve the optimal connection between people and technology and fully emphasize formative capacity of the human being.

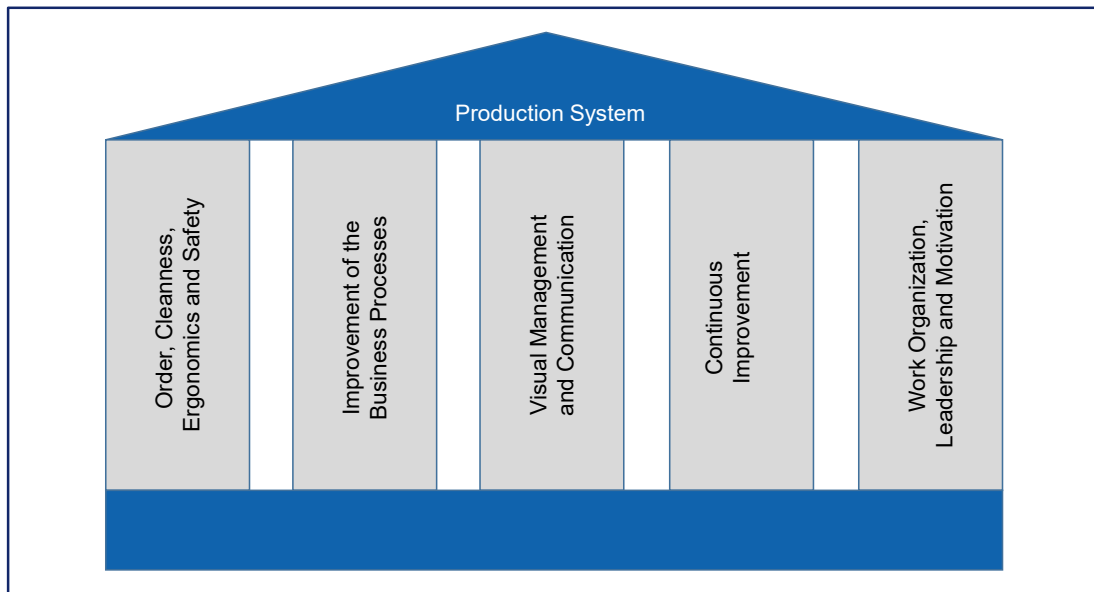


Figure 1: integrated production system

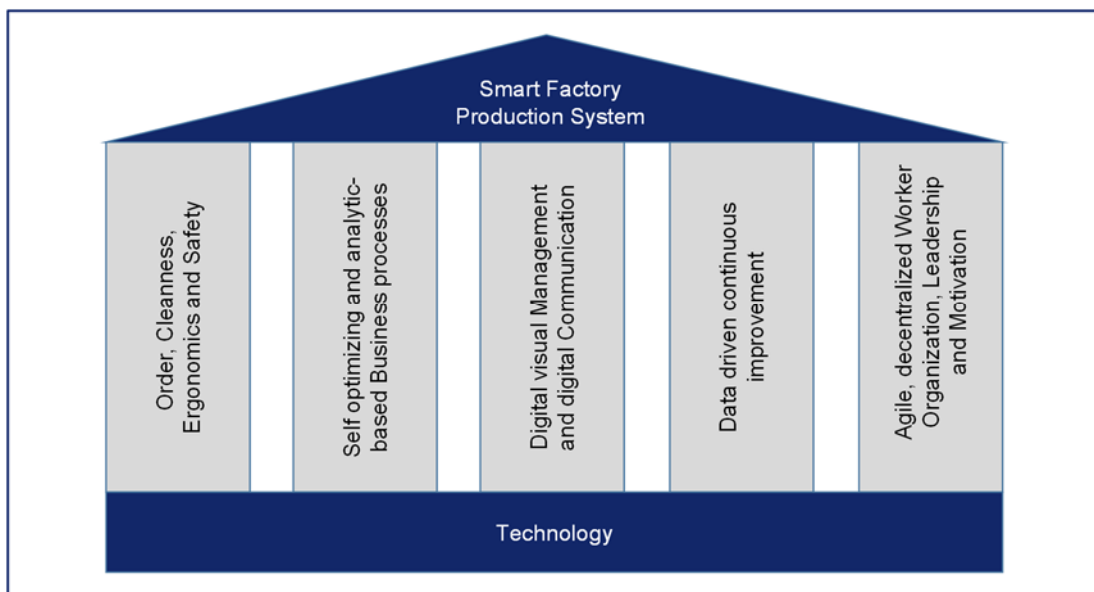


Figure 2: integrated production system in the smart factory

This also changes the workplace design. The digital avatar of the employee in connection with intelligent assembly systems, which automatically adapt to the circumstances of the employee (size, disabilities, performance, etc.), makes it an optimal symbiotic overall system. Big Data systems and the data generated in a Smart Factory are the starting point for continuous improvements and provide insights that lead to a higher level of optimization. Even a Smart Factory isn't implemented by a single project – regardless of the budget and the employees involved. It is a continuous improvement process towards optimal value-adding processes.

Smart Factory

Even in a Smart Factory, the human being is in the center – just as it was in the Lean era. Assistance systems, demand-oriented information provision with order and process data through the Smart Factory (SAP, MES, digital shadow/twin), human-robot collaboration will in future ensure the optimal supply of information and support for all those involved in the value-added. The human will continue to be the source of continuous improvement in production, but support by Big Data systems. This makes lifelong learning particularly important in a Smart Factory – for all those involved.

Logistics is also strongly influenced by Industry 4.0. In the Lean context, logistics is a type of waste that is necessary but which must be minimized and thus automated at the same time. There, the self-control of transport orders ensures a reduction of the necessary waste. New automation solutions with robots on AGVs also show ways of creating logistics in value adding way.

Coordination with the product is based on the digital shadow. Another advantage is that sequential processes are replaced by parallel and swarm-based approaches, which leads to a further increase in availability and at the same time to an increase in scalability. If one mobile logistics assistant fails, someone else from the swarm simply takes over the tasks. This also increases the flexibility of the overall system.

Conclusion

It turns out that Lean approaches can be very well combined with Industry 4.0 approaches thus, a consequent further development of lean approaches by means of new technologies take place. In summary, a transformation to a Smart Factory can achieve a productivity increase of around 30%, similar to Lean transformation.

The Company

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